Title: Just a Typical American Student?

Brief Overview:

Working in groups, students will use a graphing calculator and the instructional activity sheets to gather data, calculate statistics, construct graphs, and make inferences. The students will complete several activity sheets and communicate their findings in a summary letter.

Link to Standards:

- **Problem Solving** The students will demonstrate the ability to collect, organize, and make inferences about data.

- **Communication** The students will be able to communicate a summary of their class' characteristics in a letter.

- **Reasoning** The students will be able to select the appropriate measure of statistics in describing their class.

- **Measurement** The students will be able to select appropriate units to make and use measurements to describe/compare data.

- **Statistics** The students will develop an appreciation for statistical methods as a means for making inferences based on data analysis.

Grade/Level:

Grades 8–10

Duration/Length:

Three 90-minute periods or five 50-minute periods

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- Computing the mean, median, mode, and range
- Constructing and interpreting bar graphs, box and whisker plots, and scatter plots.
- Computing the percentage of increase or decrease.
- Using a TI-83 to enter data and calculate statistics.

Objectives:

Students will:

- perform a specific duty within a group.
- use graphing calculators to organize, graph, and interpret a data set.
- cooperate in the completion of the group's activity sheets and summary letter.
- recognize appropriate units of measures.

Materials/Resources/Printed Materials:

- TI-83 overhead projector (1)
- Scale (1)
- Tape measure (several)
- Toothpicks and rulers

per group:

- TI-83 graphing calculators (4)
- Student survey sheet (4)
- Class spreadsheet (2)
- Activity sheets (1)

Development/Procedures:

- The teacher should familiarize the class with various calculator functions using a small data set.

- Students will receive the guided activity sheets, TI-83 graphics calculators, survey sheets, and class summary database sheets.

- The teacher will guide the class through the activity sheets including the TI-83 calculator instructions.

- Students will work cooperatively in groups of four towards completion of five activities.

    1. Summary Statistics of height
    2. Bar Graphs of age
    3. Box & Whisker plots of heights (boys vs. girls vs. class)
    4. Scatter plots of arm span versus height
    5. Summary letter

- Students will submit one completed activity packet per group.

- Extension activities are provided for further analysis at the teacher's discretion.

Evaluation:

The teacher will circulate among the group to ensure that they are on task. A group evaluation will be based on performance, time on task, quality of discussion, and completion of the activity sheets. The activity sheets and summary letter will be evaluated separately.

Extension/Follow Up:

1. Have the groups use the techniques developed throughout this unit to analyze other sets of data obtained from their class spreadsheet information.

2. Have the groups present their findings orally to the class.

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GROUP ORGANIZATION SHEET

DUTIES:

Group Leader

The Group Leader will keep the group focused on the task; assist other group members in their jobs; delegate jobs; oversee cooperation; and be responsible for the overall quality of the product.

Calculator Operator

The Calculator Operator will input data into the calculator; run appropriate procedures to obtain the required results; and interpret the calculator output.

Activity Reporter

The Activity Reporter will document the group's responses to the activity sheet questions and assist the group in interpreting the results for the group letter.

Letter Writer

The Letter Writer will be responsible for the organization and completeness of the letter.

ALL GROUP MEMBERS

While each student has a primary role as outlined above, each member of the group is responsible for the final activity report and letter. Working together as a team towards a common goal is our most important objective.

SURVEY FOR DATABASE

Please answer the following questions anonymously. These data are being collected for educational purposes and will form a database for the class to analyze.

1. What is your gender (male/female)? _____

2. What is your height in inches? _____

3. What is length of your arm span in inches? _____

4. What is your age (year/month)? _____

5. What is your favorite number from 1-10? _____

6. How many hours a week do you spend on school homework? _____

7. If you have an after school job, how many hours a week do you typically work? _____

8. How many compact discs (music) do you own? _____

9. How do you usually get to school (walk, car, bus, bicycle, other)? _____

10. How many minutes does it take you to travel from home to school? _____

11. What type of housing do you live in (apartment, house, townhouse, condo, other)? _____

12. How many hours of TV do you watch weekly? _____

13. How many children are in your family? _____

14. What is your favorite color? _____

15. What is your shoe size? _____

CLASS SPREADSHEET

Gender	Age	Height	Arm Span		

ACTIVITY #1 - SUMMARY STATISTICS

I. Turn calculator on.

II. Enter the height data into list one, L1.

    A. Clear all existing data by pressing **2nd   MEM**, then select option #4, then **ENTER**.

    B. Press **STAT** button.

    C. Press selection # 1 - "EDIT"

    D. Enter the data one number at a time pressing **ENTER** each time.

    E. Note: Your calculator has a **SORT** function located in your **STAT** Directory. Calculating your statistics will be easier if your <u>lists</u> are ordered in <u>ascending</u> order.

III. Compute the summary statistics for the height of your class.

    A. Enter **STAT**

    B. Move the cursor to "CALC", then press **ENTER**, then **ENTER** again.

    C. Answer the following questions associated with the summary statistics.

        1. What is the minimum height? _____

        2. What is the maximum height? _____

        3. What is the range of the heights? _____

        4. What is the mode of the heights? _____

        5. How many data points are there? n = _____

        6. What is the sum of the numbers?   x = _____

7. What is the median of the data? Q2 = _____

8. Give the first Quartile value. Q1 = _____

9. Give the third Quartile value. Q3 = _____

IV. Interpretive Questions -- Provided an explanation for each answer.

A. Is any student in our class EXACTLY average height?

B. Which statistic (mean or median) would better describe your class?

C. Would the mean height of all the students in your grade be similar to the mean height of your class?

D. Would the mean height of all the students in your school be similar to the mean height of your class?

E. Suppose we add Shaquille O'Neal (7' 2") to your class. How will this affect the statistics for the class?

	INCREASED	DECREASED	NO CHANGE
Mean -			
Median -			
Mode -			
Range -			

F. <u>Actually add</u> Shaquille O'Neal's height (7' 2") to your data list. Calculate a new set of statistics (see III). Use these statistics, as well as those calculated without Shaquille O'Neal to complete the table below. Recall that the percentage of increase/decrease can be obtained by dividing the difference by the original value.

Statistic	Without O'Neal	With O'Neal	Percent Change
Mean			
Median			
Mode			
Range			

G. Which statistic was affected the most by the addition of O'Neal? _____ Which statistic was affected the least? _____ Are there any statistics that were not affected? _____

ACTIVITY #2 - BAR GRAPHS (HISTOGRAMS)

I. Enter the age data into List 1, L1.

    A. Clear all existing data by pressing **2nd   MEM**, then select option # 4, then press **ENTER**.

    B. Enter the data into L1 by pressing **STAT** and selection option # 1 - "EDIT". Enter the data one number at a time pressing **ENTER** each time. You may want to "SORT" your data before calculating any statistics or graphs.

    C. Move to L2 and place a value of 1 for each age.

II. Construct a bar graph of the ages.

    A. Press **2nd**, then **STAT PLOT**, then **ENTER**.

    B. Press **ENTER** to highlight plots "ON".

    C. Move the cursor down to "TYPE" and across to highlight the bar graph. Then press **ENTER**.

    D. Move to "XLIST" and press **2nd L1**.

    E. Move to "FREQ" and press **2nd L2**.

    F. Setup the window (axis parameters) for your graph.

        1. Press the **WINDOW** button.
        2. Enter the "xmin" of your data.
        3. Enter the "xmax" value of your data.
        4. Enter a "xscl" value of 5.
        5. Enter a "ymin" value of 0.
        6. Enter a "ymax" value of 6
        7. Enter a "yscl" value of 1.
        8. Enter a "xres" value of 1.

    G. Press **ENTER** and then **GRAPH**

III. Sketch the Bar Graph.

Use the area below to sketch the bar graph developed by the calculator.
Remember to start with your minimum age. Use caution in selecting the
appropriate range for your age distribution.
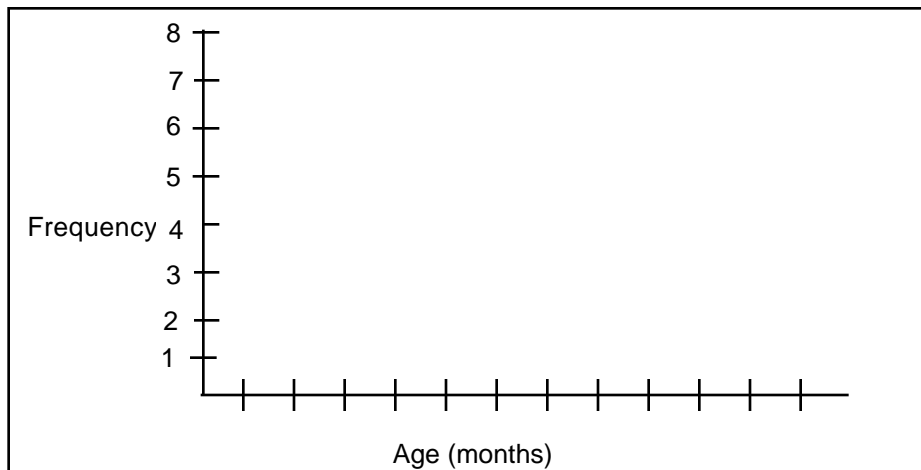
IV. Interpretive Questions.

   A. Which interval of age has the most students? _____ least? _____

   B. <u>Estimate</u> the interval of the average age by looking at the graph. Draw
       a vertical line on the graph where you feel the mean is located (label
       this estimate). Which interval includes your estimate? _____

   C. Check your estimate by using the **STAT** feature of your calculator.

       1. Press the **STAT** button, arrow over to "CALC", press **ENTER**,
           then **ENTER** again to get your statistics.

       2. What is the <u>calculated</u> value of the mean? _____

       3. Does this value for the mean lie within the interval of your
           estimate? _____

       4. Draw another vertical line for the real mean (label this mean).

   D. Using your graph, are most of the students younger or older than the
       real mean? _____Explain._____
_____
_____

ACTIVITY #3 - BOX & WHISKER PLOT

I. Clear any existing data in the calculator's lists by pressing **2nd MEM**, then option 4, then **ENTER**.

II. Enter the height data for all the girls in the class.

    A. Press **STAT** then select "EDIT", and enter the data into L1.

    B. Move over to L2 and enter a value of one to match each height.

III. Draw the Box plot for the girl's height.

    A. Press **2nd   STAT PLOT**, then **ENTER.**

    B. Move to plots "ON", then **ENTER**.

    C. Cursor down and then over to the middle box and whisker plot, then **ENTER**.

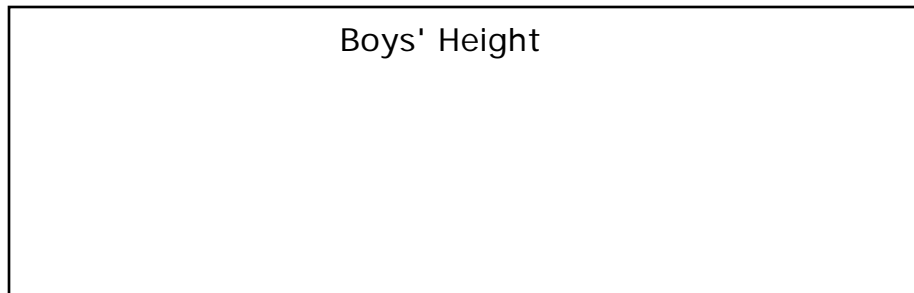   D. Move to "XLIST" and press **2nd L1**.

    E. Move to "FREQ" and press **2nd L2**.

    F. Set up the plot parameters by pressing **ZOOM** , then selection # 9. The graph should appear at this time.

    G. Sketch the girls graph in the space provided below. Use the **TRACE** key and cursor across your graph to find the minimum, Q1, MED, Q3, and the maximum. Label these numbers on your sketch.

Girls' Height

IV. Repeat the steps outlined in paragraph III and create the box and whisker plot for the boy's heights. Use list 3 (L3) for the data and list 4 (L4) for the corresponding values of one. Remember to change L1 to L3 and L2 to L4 when you set up your "XLIST" and "FREQ". Sketch and label the plot for the boy's height in the space below.

```
┌─────────────────────────────────────────────┐
│               Boys' Height                    │
│                                               │
│                                               │
│                                               │
│                                               │
│                                               │
└─────────────────────────────────────────────┘
```

V. Interpretive Questions.

A. Who has the higher median, boys or girls? _____

B. Since the interquartile range (width of the box) represents the middle 50% of the data, determine which group of data (boys or girls) has more entries located within this range. What can you conclude from this result?

D. From each graph, compute the range of the boys' height? _____ girls' height? _____

E. Using the ranges listed in question D, which data set is more spread out, boys or girls? _____

F. Using the graphs, who is taller, boys or girls? EXPLAIN your selection.

V. Draw the box plot for the entire class. Note - save this list for activity # 4.

    A. Press the **STAT** key, then select "EDIT". Arrow down to the end of L1 and add the boys' height to the list.

    B. Add additional values of one into L2 to match each height.

    C. Follow the steps outlined in Part III to set up the Box plot for the entire class.

    D. Sketch and label the Box plot for the class in the space below.

Class Height

    E. Is the boys' height representative of the entire class? _____ Explain.

    F. Is the girls' height representative of the entire class? _____ Explain.

ACTIVITY #4 - SCATTER PLOT

I. Data Entry.

    A. Press **STAT** then "EDIT" and enter all the heights into L1. Note, you may already have these in L1 from activity # 3.

    B. Clear Lists 2 by moving the cursor up to the L2 heading, press **CLEAR**, then **ENTER**. Repeat for L3 and L4.

    C. Enter the arm span data into L2. Be sure to enter the correct arm span for each height.

II. Draw a scatter plot of the arm span versus height.

    A. Press **2nd   STAT PLOT**, then **ENTER**.

    B. Setup the plot parameters.

        1. Move the cursor to Plot "ON", then **ENTER**.
        2. Move the cursor to "TYPE" , then **ENTER**.
        3. For "XLIST", press **2nd L1.**
        4. For "FREQ", press **2nd L2.**
        5. For "MARK", use the 1st entry (the box).

    C. Press **ZOOM**, then selection # 9 to graph your plot.

III. Sketch the scatter plot. Use the space provided below (or graph paper).

Arm Span vs. Height

Arm
Span

Height

A. Plot the height, L1, along the x-axis (horizontal) and the arm span, L2, along the y-axis (vertical).

B. Scale each axis by 2s starting from your minimum value up to your maximum value. Use a ruler to ensure evenly spaced marks.

IV. Interpretive Questions.

A. Do the points appear to be along a line (linear)?

B. Draw a straight line through as many points as possible with approximately the same number of points above and below your line.

C. Determine if there are any points which seem to be far away from the others. If your graph has such points, cross them out and draw another line without using the points that are crossed out. The points you crossed out are called "outliers".

D. Can you guess the arm span of a student who is 60.5 in. tall? Explain.

E. Retrieve the scatter plot on your calculator.

F. Press **2nd DRAW**, then select option 4 to draw a vertical line. Move the cursor right or left until the height value (x=) is as close as possible to 60.5 inches.

G. Set a toothpick over the display of your calculator to simulate the straight line you drew on your sketch.

H. Cursor up or down (in the y-direction) to the toothpick. What is the predicted arm span (y-value) for the height of 60.5 in.? _____

I. Compare the calculator's prediction to your guess in question D. Explain.

J. Now lets add Shaquille O'Neal's height to our problem. If he is 7' 2"
   tall, use your sketch to estimate his arm span. What is your estimate?
   _____

K. Is there any connection between the height and arm span of your class?
   Explain.

L. Can this model be used to estimate the arm span of any student your
   school? Explain.

ACTIVITY #5 - LETTER

Let's pretend your school has a sister school in Japan. Each year the two schools take turns sending a student delegation along with a faculty advisor on an international exchange visit to the other school. Their student council president has written a letter to your school asking what a "typical American student is like." Your job is to write a letter back to them describing your class. This letter should contain the following information:

- A statistical description of the height.

- A brief summary of your age data.

- How American boys and girls might differ in their heights.

- At least two other characteristics that you can summarize from your class spreadsheets.

Remember to include an opening paragraph describing the goal of your letter. Then address each of the above issues. Lastly, write a closing summary to the Japanese student council president.